Integration of Pollution Prevention into Work Planning and Control
For Bench scale Research Experiments – Robert DiNardo, Diane Cabelli, Pat Carr, Ann Emrick, Ron Gill, Robert Colichio, and Robert Sabatini

Brookhaven National Laboratory's (BNL) broad mission is to produce excellent science in a safe, environmentally responsible manner. A strong Pollution Prevention (P2) Program is an essential element of successful accomplishment of this mission and BNL's Environmental Management System. The BNL P2 Program reflects the National and Department of Energy pollution prevention goals and policies and represents an ongoing effort to make pollution prevention and waste minimization and integral part of the BNL operating philosophy.

BNL is committed to integrating environmental stewardship into all facets of its mission. This stewardship includes integrating pollution prevention, waste minimization, resource conservation, and environmental compliance into all of planning and decision-making. Cost-effective practices are used to eliminate, minimize, or mitigate environmental impacts. A good example of this integration is the use of our Experimental Safety Review process to identify pollution prevention opportunities.

BNL has Work Planning and Control process in place that requires all work to undergo an ESH review. Research activities are reviewed under the Experimental Safety Review (ESR) system. Researchers at BNL have embraced the ESR system in a way that incorporates P2 into the planning process. The overall goal of the P2 Program is to create a systems approach that integrates pollution prevention and waste minimization, resource conservation, recycling, and affirmative procurement into all planning and decision making and this is an example of a successful integration.

During the ESR process, researchers identify P2 or Waste Minimization opportunities that they may or may not have resources to implement. Since all workers, not just the Principal Investigators, are involved we get many suggestions for P2 opportunities. The ideas range from equipment to labor that is necessary to develop protocols, that ultimately reduces or avoids a hazardous waste. The opportunities are written up and submitted as proposals to the P2 Program. A few examples of recent successful proposals are:

1. Development of a technique to use fluorescently labeled oligonucleotides to replace standard radioactive assays to study induction and repair of DNA damage Avoided the annual generation of:
    - Radioactive Waste Solid: 72 CF
    - Mixed Waste Liquid: 35 gal

- Rad/DIS waste Solid: 324 cuft
- Haz waste liquid (Rad component DIS): 108 gal

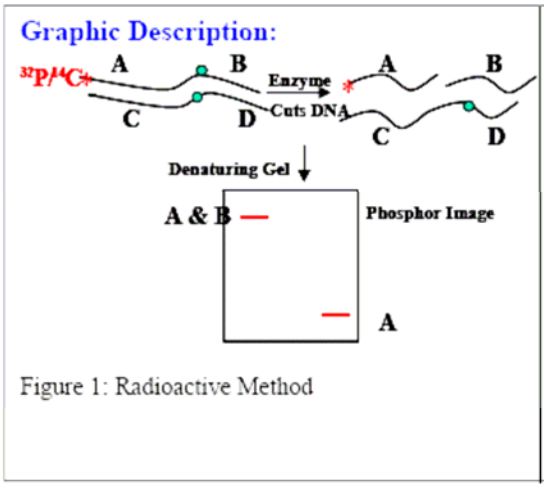

Figure 1: Radioactive Method

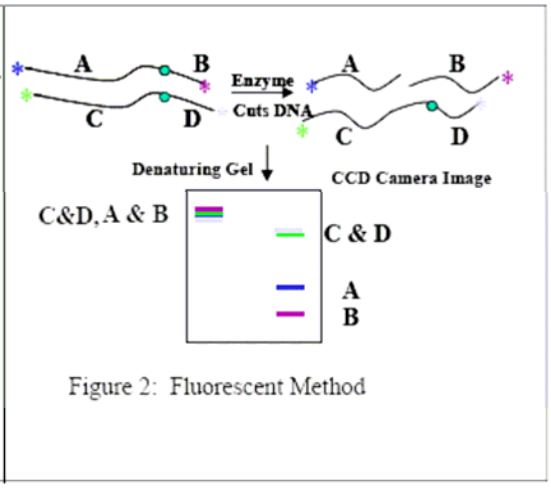

Figure 2: Fluorescent Method

2. Minimizing Use of ^{32}P; A novel, fluorescence- based assay for ATPases and Kinases –funds were allocated to support labor which ultimately lead to the development of a protocol that used fluorescence instead of radioactivity to conduct these assays. This resulted in an avoidance of 20 gal mixed waste/year.
3. Minimization of Silver Waste from Silver-Staining Electrophoretic Mini-Gels – funds were allocated for the purchase of silver staining kits. Contributed labor was used to develop a protocol to reduce the amount of reagents necessary for successful results. This resulted in a ten-fold decrease in reagents used and waste generated which equates to a reduction of ~200 gallons of hazardous waste/year from this work.
4. A microplate scintillation counter for reduction in mixed and radioactive waste generation. A post-doc used this at another institution and identified it as a P2 opportunity for BNL. This saved 28ltrs of mixed waste/year.

5. Installation of a video camera system in the Building 830 transmission electron microscope (TEM). This eliminated the use of standard photographic processing thereby eliminating 32 gals/year of hazardous chemical waste generation.